सत्यमेव जयते

नागर विमानन मंत्रालय, भारत सरकार

MINISTRY OF CIVIL AVIATION, GOVERNMENT OF INDIA

भारतीय विमानपत्तन प्राधिकरण

AIRPORTS AUTHORITY OF INDIA

ICAO APAC SBAS-GBAS IMPLEMENTATION WORKSHOP FOR AIRSPACE USERS

"Enhancing airport accessibility and safety on final approach with SBAS and GBAS"

14th to 16th October 2025

Bengaluru, India

Procedure Design & Safety assessment of GBAS/SBAS procedures

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Overview

SBAS implementation in India

Why SBAS/GBAS?

SBAS/GBAS design criteria

SBAS implementation process

SBAS implementation challenges

Safety assessment

SBAS implementation in India

- ***2015****- GAGAN certified for LPV APV1*
- ***2017****- LPV approaches design process initiated.*
- ***2018 -*** *AAI B350 retro fitted with SBAS receiver.*
- ***05.04.2019*** *LPV approaches of Kishangarh were approved by DGCA for simulator validation .*
- ***2021*** *-AAI B350 crew trained for LPV approaches.*
- ***23.04.2022*** *- Successful SIM validation of LPV runway 05 and runway 23- Kishangarh airport were conducted by Indigo on ATR 600 simulator at FSTC Hyderabad.*
- **28.04.2022***- Successful flight trial of LPV runway 05 and runway 23- Kishangarh airport were conducted by Indigo ATR 600.*
- **12.05.2022** *DGCA approved LPV approaches of runway 05 and runway 23 of kishangarh airport for promulgation.*
- ***14.07.2022****-LPV RWY 05 and RWY 23- Kishangarh were implemented.*
- *At present* ***23 SBAS APV 1*** *approach procedures implemented in India.*
- ***19 SBAS*** *approaches are in various phases of implementation.*
- *It is planned to implement SBAS APV 1 approaches at all non-precision runways.*

SBAS implementation challenges

- *Limited fleet capability(ATR72/Q400/B350) to execute SBAS(LPV) procedures.*
- *Conduct of simulator and flight trial.*
- *SBAS certification for LPV CAT I (current certification is only for APV 1 approaches).*
- *Interoperability of SBAS receivers.*
- *SBAS specific training requirements for Procedure designer/ATC/Pilots/Regulator.*
- *India being in equatorial and low latitude ionospheric region, which is the most complex and dynamic ionospheric region due to several phenomenon operating over the magnetic equator, performance of GAGAN(SBAS) is affected by ionospheric disturbances specially during peak solar storm activity.*

SBAS
design criteria

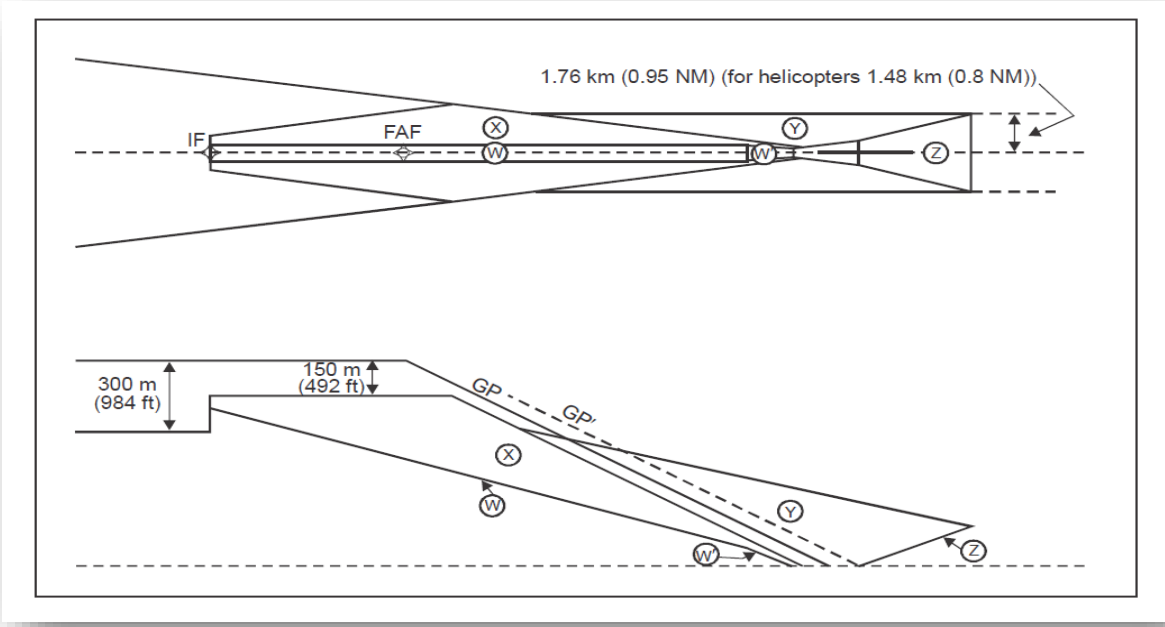
SBAS APV 1

- *Criteria for **Initial Approach Segment** is same as general criteria for PBN approach.*
- *In the **Intermediate Approach Segment** any sensor can be used; however, the transition to the SBAS navigation shall be made 3.7 km (2.0 NM) prior to the FAF.*
- *The **intermediate approach segment** may incorporate a PBN route ending with a **radius-to-fix turn** to the final approach course.*
- *The **APV I or CAT I segment** shall be aligned with the runway centre line except where not physically practicable due to obstacles (max 5°) and contain the **final approach**, the **initial and the intermediate missed approach segments.***
- ***GP angle** should be consistent with PAPI, when implemented on ILS runway aligned with ILS GP to ensure alignment with existing lighting system. Desirable GP angle is 3 degree.*
- *The **missed approach turn** shall be prescribed at a **designated TP (flyover waypoint)**. Turns at a designated altitude/height or "as soon as practicable" cannot be implemented because of the current SBAS receiver capabilities.*

SBAS
design criteria

SBAS APV 1 OAS

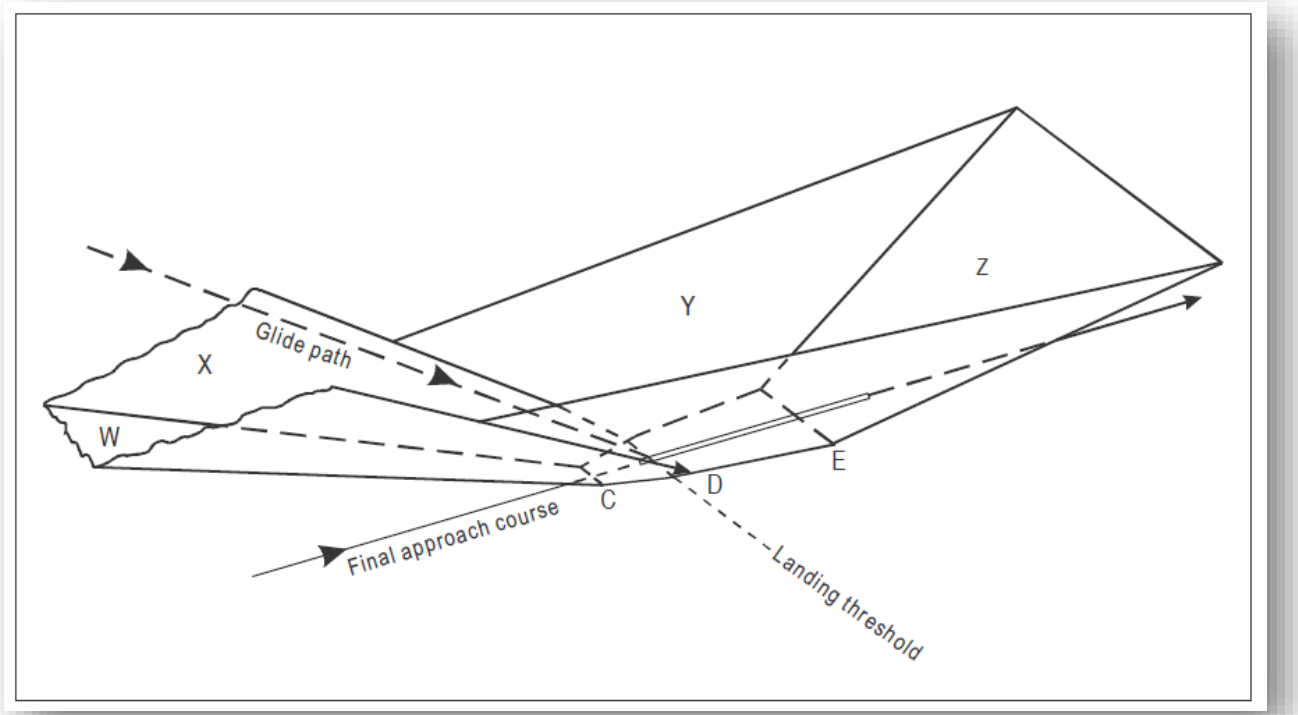
- *The **SBAS APV I OAS** consists of up to seven sloping plane surfaces (denoted by letters W, W', X, Y, and Z)*
- *OAS is assessed for obstacles to get OCA of the procedure..*
- *Dimensions of OAS depend on approach geometry (GARP-THR distance, GP, RDH & type of SBAS procedure(APV 1 or CAT 1))*



SBAS
design criteria

SBAS CAT 1 OAS

*The **SBAS CAT I OAS** contains the following sloping surfaces: W, X, Y and Z, which are equal to the **ILS CAT I OAS** surfaces*



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SBAS
design criteria

FAS Data Quality Requirements for SBAS/GBAS

Data element	*Accuracy*	*Resolution*	*Integrity*
FPAP (latitude and longitude)	0.3 m (1 ft)	0.0005″ (0.01″)	10^{-8}
LTP/FTP (latitude and longitude)	0.3 m (1 ft)	0.0005″ (0.01″)	10^{-8}
LTP/FTP (ellipsoidal height)	0.25 m	0.1 m	10^{-8}
Approach TCH	0.5 m	0.05 m	10^{-8}
Glide path angle	0.01°	0.01°	N/A
Course width	N/A	0.25 m	10^{-8}
Delta length offset	N/A	8 m	N/A

SBAS
design criteria

Determination of FPAP and GARP

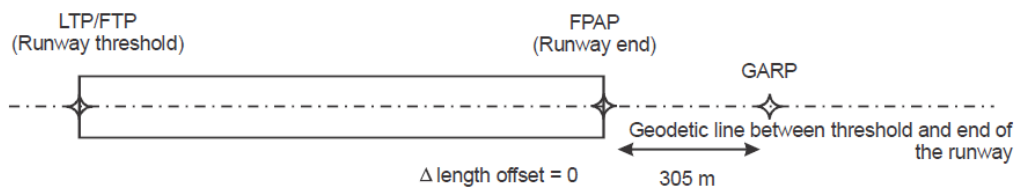

Figure III-2-6-1. FPAP location (no existing ILS for the approach)

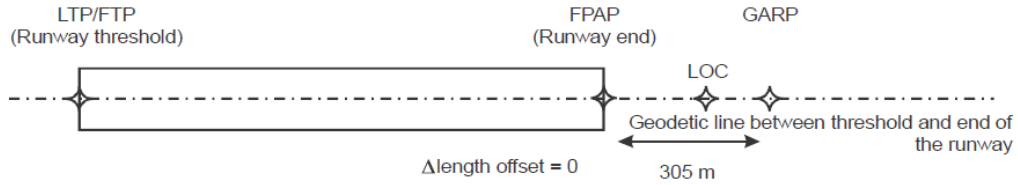

Figure III-2-6-2. FPAP location (ILS exists for the approach and LOC within 305 metres from runway end)

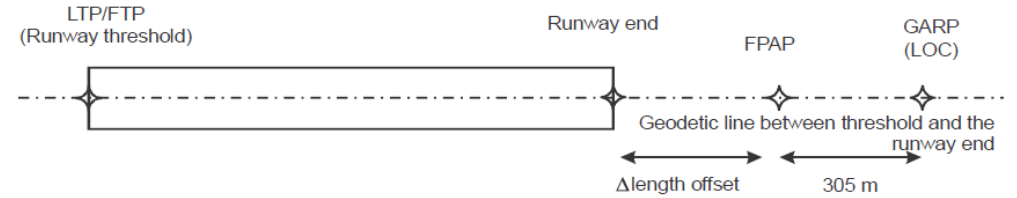

Figure III-2-6-3. FPAP location (ILS exists and LOC more than 305 m from the runway end)

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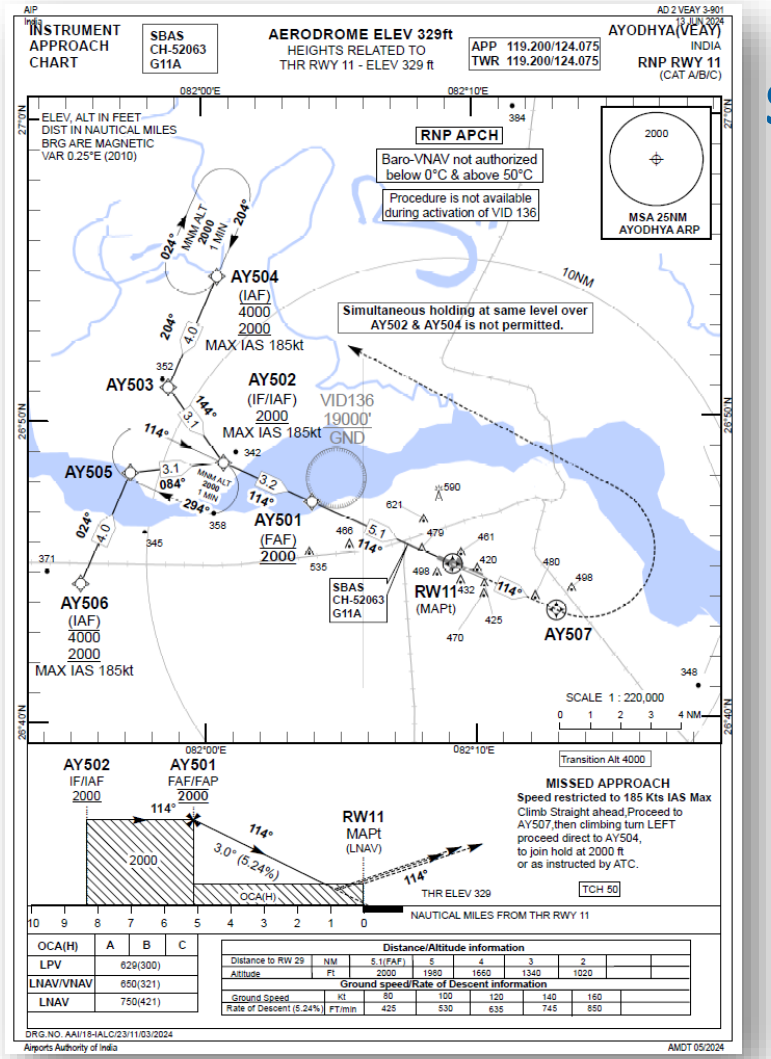
SBAS
design criteria



SBAS APV 1 APPROACH CHART

Following information shall be promulgated forprocedures based on SBAS:

1. *Channel number*
2. *Reference path identifier (RPI).*
3. *SBAS service provider*

Example:

SBAS
CH-52063
G11A

SBAS
design criteria

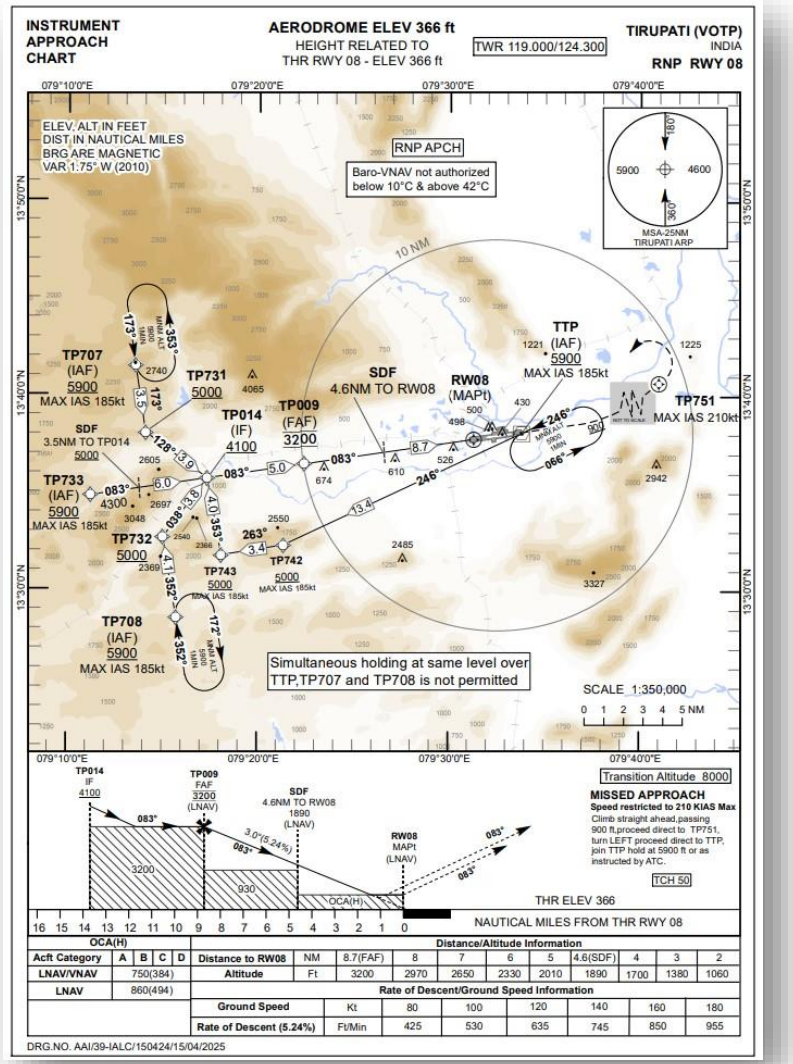
SBAS APV 1 FAS DB

Operation Type	0
SBAS Provider	3 (GAGAN)
Airport Identifier	VOTV
Runway	32
Runway Letter	0 (None)
Approach Performance Designator	0
Route Indicator	Z
Reference Path Data Selector	0
Reference Path Identifier	G32A
LTP/FTP Latitude	082819.8435N
LTP/FTP Longitude	0765546.7405E
LTP/FTP Ellipsoidal Height (metres)	-92.1
FPAP Latitude	082935.5020N
Delta FPAP Latitude (seconds)	75.6585
FPAP Longitude	0765432.9750E
Delta FPAP Longitude (seconds)	-73.7655
Threshold Crossing Height	50.0
TCH Units Selector	0 (feet)
Glidepath Angle (degrees)	3.00
Course Width (metres)	105.00
Length Offset (metres)	0
HAL (metres)	40.0
VAL (metres)	50.0

Output data

Data Block	30 16 14 0F 16 20 D0 00 01 32 33 07 07 C8 A2 03 69 BE 03 21 67 10 15 4F 02 B5 BF FD F4 01 2C 01 64 00 C8 FA 7A 6D A1 B5
Calculated CRC Value	7A6DA1B5
Supplied CRC Value	7A6DA1B5
Comparison Result	OK

SBAS design criteria



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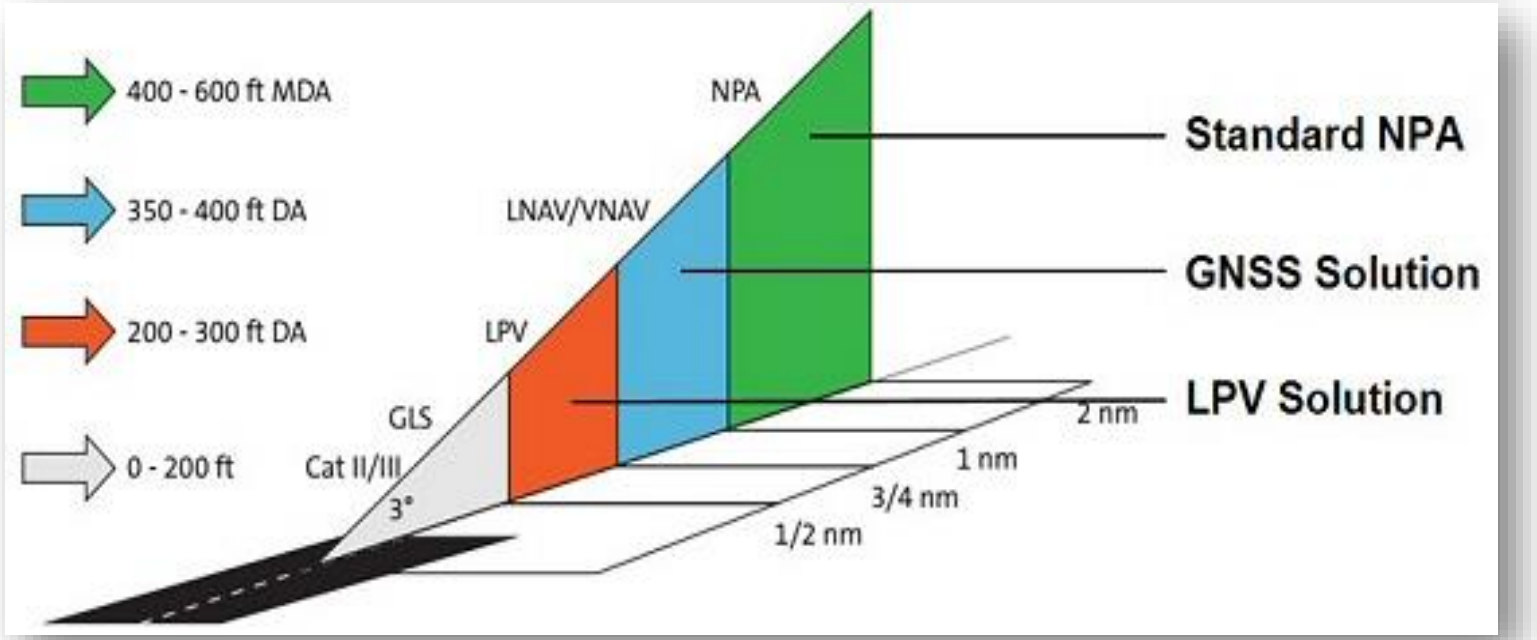
Why SBAS?

- *Serves all phases of flight (Enroute/Terminal/Approach).*
- *Supports runway aligned , vertically guided and localizer performance approaches (APV, LP & LPV).*
- *LPVs are operationally equivalent to Instrument Landing System (ILS) but are more economical and can be implemented at non-instrument and non-precision runways.*
- *Satellite based accurate Vertical guidance, not sensitive to temperature/pressure fluctuations and has no barometric / temperature limitations.*
- *GNSS navigation alone requires RAIM checks. SBAS operational criteria include integrity assurance and eliminate the need for GNSS avionics Receiver Autonomous Integrity Monitoring (RAIM) checks.*
- *Single navigation aid serving entire country/continent, if adjoining countries collaborate (EU) this can be a very cost effective solution.*
- *SBAS supports simultaneous parallel runway operations.*
- *Huge cost benefit for ANSP, as there is no need of ground based navigation infrastructure.*

Why SBAS ?

- *Allows the flexibility to design more efficient airspace and instrument procedures that collectively improve safety, access, capacity and efficiency.*
- *All wx access access to airports where siting of ground based navigation aid is not feasible due to obstacles/terrain environment or paucity of land (RWY 32 Mumbai Airport).*
- *No coverage restrictions as there is no line of sight issue.*
- *Reduced maintenance cost and no flight inspection cost.*

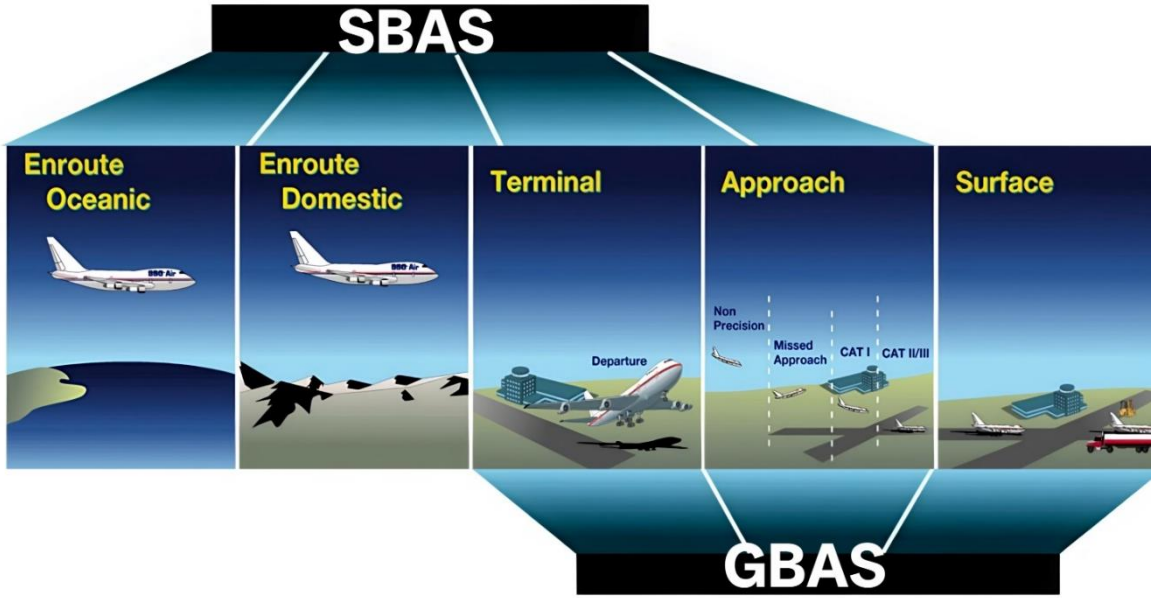


Why GBAS?

- *Supports all types of Precision Approaches (CATI/II/III).*
- *Supports CAT II/III operations up to 3.2° glide angle.*
- *Supports RF turns to the final approach course.*
- *Single GBAS installation is capable of providing multiple precision approaches not only to all the runways at the airport on which it is installed but also to the nearby airports within the operational range (26 approaches per GBAS station).*
- *Variable glideslope capability.*
- *Supports simultaneous parallel approaches.*

Why GBAS?

- *Flexible siting instead of being located at end of the RWY.*
- *Instead of ILS beam, digital signals are transmitted therefore more stable signals.*
- *Reduction of ILS critical and sensitive areas.*
- *Reduced maintenance cost and no flight inspection cost.*



SBAS Approach Procedures

Implementation Process in India

- *DGCA has issued Civil Aviation Requirements(CAR) for the Design, validation and promulgation of Instrument flight procedure (IFP) in India (Section 9, Series P, Part 1.*
- *Initiation of flight procedure is undertaken by Authorized Procedure Designer (APD) after issuance of IFP order by head of FPD section.*
- *Acquisition and validation of relevant data is done by data manager of FPD section ensuring the data quality requirements for SBAS procedure design.*
- *GAGAN (SBAS) channel no. is obtained using ICAO SBAS Channel Allocation Tool.*
- *Conceptual design of the procedure is prepared by procedure designer and is shared with all the stakeholders for their feedback.*
- *Draft procedure after incorporation of feedback is submitted for Ground validation and criteria verification by independent procedure designer.*
- *Safety assessment is carried out and the procedure is amended to mitigate the hazards if any.*
- *Draft IFP chart is submitted for Quality check along with Tabular description and FAS DB.*
- *Procedure design document is sent to Chief Procedure Designer (CPD) for verification.*

SBAS Approach Procedures

Implementation Process in India

- *After verification by CPD, procedure design package is submitted to regulator(DGCA) through online portal (eGCA) for necessary approvals.*
- *A unique application no. is generated by eGCA portal which is used to track and update the submitted procedure.*
- *Flight validation of the procedure is conducted after receiving DGCA approval for the same.*
- *Flight procedure validation reports are uploaded online by FVP through eGCA portal for examination by regulator.*
- *After successful flight validation of the procedure, promulgation approval is accorded online by the regulator (DGCA).*
- *Whole approval process is online.*
- *On receipt of promulgation approval, final chart is prepared and is sent for verification by CPD.*
- *Final chart, tabular description and FAS DB is sent to AIS section for promulgation from suitable AIRCAC date.*
- *SBAS IFP sensitization class for users (Local ATC/Airlines) and implementation level safety assessment are conducted before implementation of the procedure.*
- *Post implementation feedback is obtained for initial six months and are shared with the regulator (DGCA).*
- *Promulgated IFP is reviewed periodically to meet the applicable standards and requirements.*

Safety Assessment

- ***Concept and Design level safety assessment*** *is carried out before the submission of the SBAS procedure to the regulator (DGCA) for approval, to assess design related safety issues.*

  -design criteria, flyability, obstacles clearance, airspace requirements, traffic patterns, local ATC requirements, connection to SIDs/STARs, ATC/pilot workload, airport infrastructure, CNS infrastructure, fleet capability etc.

- ***Implementation level safety assessment*** *is carried out after the promulgation approval of SBAS procedure by the regulator & before the implementation to assess the safety impact of introduction of IFP in ATM environment.*

  Phraseology/separation standards/GNSS outage or spoofing/masking/ATC-crew training/SBAS signal loss/degradation, contingency procedures, SBAS receiver malfunction, mix mode of operation (PBN/conventional) etc.

Thank You!

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